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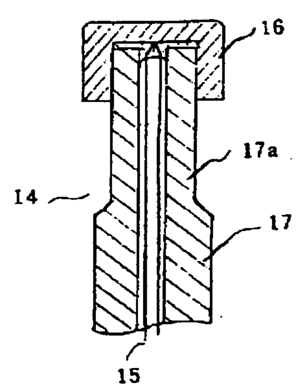
(54)【発明の名称】　温度検出装置および半導体製造装置

(57)【要約】
【目的】半導体基板、或いはガラス基板の温度を均一、且つ、正確に制御する。
【構成】半導体基板、或いはガラス基板を支持ピン１４で支持する。これら基板を加熱処理する半導体製造装置の温度検出装置として、支持ピン内部に熱電対１５を設ける。支持ピン１４は熱伝導率の高い材質で先端部を構成し、基板よりも熱伝導率の低い無機材質で基部１７を構成する。熱電対１５は平坦な支持ピン１４の先端部に固着し、支持ピン１４の基部に頸部１７ａを設ける。

図　2




14…支持ピン
15…熱電対
16…キャップ
17…支持ピン基部
17a…基部頸部

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【特許請求の範囲】

【請求項１】半導体基板またはガラス基板を非接触で温度処理する半導体製造装置の温度検出装置において、前記半導体基板または前記ガラス基板を支持する支持ピンの少なくとも一つに熱電対を埋め込み、前記支持ピンの先端部を前記支持ピンの基部よりも熱伝導率の高い材料で平坦に構成し、前記支持ピンの基部を前記基板よりも熱伝導率の低い無機材料で構成したことを特徴とする温度検出装置。

【請求項２】請求項１において、前記支持ピンの基部を管状とし、管内先端部に接点が位置すべく前記熱電対を挿入し、該接点近傍を支持ピン先端部に固着したことを特徴とする温度検出装置。

【請求項３】請求項１または２において、前記支持ピンの基部の先端部の断面積を他端の断面積よりも小さくした温度検出装置。

【請求項４】請求項１，２または３において、上記支持ピンの先端部と上記基板との接触角を可変とする角度調節機構を設けたことを特徴とする温度検出装置。

【請求項５】請求項１，２，３または４において、前記半導体基板、又は前記ガラス基板を収納するための熱線透過型の反応容器と、前記反応容器の外側から基板の少なくとも一方の表面に加熱用熱線を照射するための熱線源とを備えた半導体製造装置に、前記温度検出装置を備えた半導体製造装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、半導体製造装置、特に赤外線ランプ，セラミックヒータ等の熱線源を使用する半導体製造装置およびそれらに用いられる温度検出装置に関する。

【０００２】

【従来の技術】半導体素子の性能を高め、かつ、性能のばらつきを少なくするには、半導体素子の製造過程中、半導体基板、或いはガラス基板の温度を均一かつ正確に制御することが必要であり、既に幾つかの対策が提案されている。

【０００３】例えば、特開平4－98135号公報に記載の温度の検出方法では、測温体を熱伝導率の高い材質からなるキャップで被覆し、熱抵抗を低減している。或いはまた、文献(JICST E91121096) ではアルミナ管を支持ピンとし、その内部に熱電対を埋め込んだ例が示されている。これら従来例では、被測定基板と測温体との間の熱抵抗を少なくしているものの、測温体と支持基盤との間の熱抵抗には十分な考慮がなされていない。従って、温度測定部を通り、多量の熱が被測定基板から流れ出すことにより、測定部の基板そのものの温度低下、並びに、測温体と被測定基板との温度差が増加する欠点が有った。また、測温体がＳＵＳ等の金属支持体を有するものでは、被測定基板にとって有害な金属汚染（例えば、Ｆ

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ｅ，Ｃｒによる汚染）を発生する欠点が有り、特開平4－148545 号公報に記載の温度測定装置では、測温体を被覆部材に内挿する例が示されているものの、被測定基板からの熱流には十分な考慮がなされていない。

【０００４】

【発明が解決しようとする課題】本発明の目的は、半導体基板、或いはガラス基板の温度を均一かつ正確に制御することが出来、有害な金属汚染の生じない改良された半導体製造装置およびその温度検出装置を提供することに有る。

【０００５】

【課題を解決するための手段】上記目的を達成するため、本発明は半導体基板、或いはガラス基板の支持ピンを兼ねる温度検出部を、熱伝導率の高い材質でその先端部（以下キャップと称する）を平坦に形成し、基板よりも熱伝導率の低い無機材質でその基部断面積を小さく形成し、熱電対の接点を前記基部に設けられた穴を通して前記キャップに固着する。このような特性を持ったキャップの材質は、低温処理にはアルミニウム又はアルミナが、高温処理にはアルミナが好都合であり、窒化珪素、或いは炭化珪素等も可能である。また、基部の材質は、石英ガラス、又はステアタイト等の酸化マグネシュウムと酸化珪素との化合物、或いは、酸化ジルコニュウムと酸化珪素との化合物が好都合である。

【０００６】

【作用】測温体（熱電対の接点）はキャップを介して基板に接触している。この時、測温体と基板の測温部との温度差は、キャップと基板との接触部の熱抵抗，キャップの熱抵抗，キャップと測温体との熱抵抗、及び基部（測温体支持部）の熱抵抗で左右される。

【０００７】本発明によれば、キャップ先端を平坦にすることによりキャップと基板との接触部の熱抵抗を減少させ、キャップの材質を熱伝導率の高いものとし、基部の熱伝導率を低いものとすることにより、キャップの熱抵抗を減少させ、基部の熱抵抗を増大させている。また、測温体を基部の管を通してキャップに固着させることにより、キャップと測温体との熱抵抗を減少させている。従って、本発明の温度検出装置では測温体と基板との熱抵抗が少なく、測温体と半導体基板の測温部との温度差は極めて少なくなる。また同時に、基部を熱伝導率の低い材料で構成し、かつ、基部のキャップ側断面積を小さくすることにより、基部の熱抵抗を大きくし、基板から失われる熱流を少なくすることが出来、基板の測温部の温度低下を減少させ、基板の温度の均一性を確保できる。更に、熱電対を支持ピン内部に閉じ込め、且つ、支持ピン基部を無機材質で構成することにより、半導体基板、或いはガラス基板が有害金属で汚染されることを防止できる。

【０００８】

【実施例】本発明に係る半導体製造装置の一実施例を図

１に示す。装置本体１は、図に示すように中空構造となっており、その中央部分に石英ガラス製の反応容器２が配設されている。反応容器２の上側空間及び下側空間には、複数の熱線照射ランプ３（例えばハロゲンランプ）が上下交差するような形で平行に並べて配置されている。装置本体１内部の天井及び床面には、金コートを施したアルミ合金製の樋状凹面反射鏡が配設されており、熱線照射ランプ３から照射された加熱用熱線が効率良く反応容器２に向けて集光するようになっている。

【０００９】外部熱線吸収板４は、熱線照射ランプ３と反応容器２との間の上下空間（熱線透過空間）にそれぞれ配置されている。本実施例の場合、同吸収板は、熱線拡散用の磨りガラス面を表面に形成した石英ガラス製のものを使用し、かつ、その全面には、冷却用窒素ガスを流すための多数の通気口５を形成した。被加工物である半導体基板６は、反応容器２の底部に設置した熱線透過性支持台７上にガードリング８を添えて装填した。一方、内部熱線吸収板９は、石英ガラス製のものを使用し、半導体基板６に接近させてその下側の熱線透過空間に配置した。同吸収板は、必要に応じて基板６の両側に配設することも可能である。

【００１０】反応ガス及びパージガスは、図面左側のガス導入系（図示せず）から反応容器２内に導入し、同容器を通過させた後、図面右側のガス排気系（図示せず）を用いて排気した。また、装置本体１の壁の内部には通水路が設けられており、装置の使用中、当該通水路に冷却水を通すことによって装置本体１を冷却した。

【００１１】基板６の温度は、装置本体１の下側に放射温度計１０を配置し、観測窓１１，透孔１３を介して測定した。測定データは、電力制御装置１２に転送し、同データに基づいて熱線照射ランプ３に供給する電力を制御した。或いはまた、基板６の温度は、図２に示す要部拡大断面図のように、熱線透過性支持台７の支持ピン１４に内装した熱電対１５で測定した。支持ピン１４は直径４㎜のアルミナからなる平坦な頂部を持つキャップ１６と直径３．５㎜ の石英ガラス管からなる基部１７とからなり、基部１７の頂部は直径２．５㎜ と絞られて基部頸部１７ａとなっている。熱電対１５はその接合部が無機接着剤によりキャップ１６に固着されている。放射温度計の場合と同じく、測定データは、電力制御装置１２に転送し、同データに基づいて熱線照射ランプ３に供給する電力を制御した。放射温度計１０と熱電対１５とは適宜切り替えて用いた。

【００１２】このほか、装置の使用中、各部材が許容温度を越えて高温になることを防ぐため、装置本体１と反応容器２との間の間隙に冷却用の窒素ガスを吹き込み、これらの部材を冷却した。

【００１３】このような製造装置により、未加工の半導体基板（シリコン基板）６を反応容器２内に装填して１０００℃の温度でアニール処理を行ったところ、基板ごとの温度のばらつきは約１℃と良好な結果を得た。ポリシリコン膜を表面に形成したシリコン基板、及びイオンドープを表面に施したシリコン基板を用いて同様のアニール処理を行ったところ、熱電対１５を用いた温度制御ではばらつきは約１℃と良好であったが、放射温度計１０を用いた温度制御ではばらつきの値は約１０℃と大きくなった。また、シリコン基板６の温度と熱電対１５による検出温度との誤差は約４℃と一定であり、シリコン基板６の温度制御には、この誤差４℃を補正して用いることにより、精度良く制御できることが明らかになった。さらに、熱電対１５を埋め込んだ支持ピン１４の近傍のシリコン基板温度とその周辺の基板温度との差は約２℃と少なく、基板の温度は均一であった。

【００１４】比較のために、支持ピンのキャップ１６を直径４㎜のアルミナで形成し、基部を同じく直径４㎜の石英ガラス管で形成し、上記の条件と同じで実験を行ったところ、シリコン基板６の温度と熱電対１５による検出温度との誤差は約７℃となり、さらに、熱電対１５を埋め込んだ支持ピン１４の近傍のシリコン基板温度とその周辺の基板温度との差は約１０℃と不均一となった。この原因は石英ガラスの熱伝導率は低いものの、その断面積が広いために半導体基板６から多量の熱が支持ピンの方へ流れ込んだためと推測される。したがって、支持ピン１４の太さは、細いほど温度測定に適しているが、機械的強度が弱まることから、応力が集中し難い頸部を細くすることが熱的にも好都合である。

【００１５】さらに比較のために、支持ピンのキャップ１６、並びに基部１７を共に直径４㎜のアルミナで形成し、上記の条件と同じで実験を行ったところ、シリコン基板６の温度と熱電対１５による検出温度との誤差は約１５℃と大きく、しかもその値は一定ではなく、さらに、熱電対１５を埋め込んだ支持ピン１４の近傍のシリコン基板温度とその周辺の基板温度との差は約４０℃と大きく、基板の温度は不均一であった。この原因も程度の差は有るものの上記の原因と同じく、基部２２の熱抵抗が低いためと推測される。

【００１６】このように、熱抵抗の低い支持ピンで半導体基板温度を測定した場合に、基板温度が不均一となる原因を調べるために、図１に示した半導体製造装置の支持台７，ガードリング８および内部熱線吸収板９を取外し、代りに、セラミックスヒータ上に半導体基板を直接載せ、そのヒータで半導体基板を加熱し、基板温度をキャップ１６および基部１７を共に直径４㎜のアルミナで形成した支持ピンに設けた熱電対１５で測定した。その結果、支持ピン１４の近傍のシリコン基板温度とその周辺の基板温度との差は約５℃と減少した。したがって、半導体基板６を接触方式で加熱する場合、基板が加熱体から受け取る熱量は、加熱体と基板との温度差に比例するため、基板に温度差が生じた場合、その温度差を減ずる作用が生じるのに対して、半導体基板６を非接触方

式、例えば、赤外線ランプで加熱する場合には、基板が受け取る熱量は均等であるため、部分的に熱の流出が生じるとその周りに温度差が生じて、特に、半導体基板6の温度が高く、支持ピンの熱抵抗が低い場合、支持ピンの周りでは半導体基板の温度変化が大きくなるものと結論される。

【0017】図3は、シリコン基板の上にシリコン酸化膜を形成する場合の本発明の別の実施例を示す。本実施例では、反応容器2の上側空間に低圧水銀ランプ18（紫外線ランプ）を配置し、反応容器2の下側空間にハロゲンランプ3（熱線照射ランプ）を配置した。キャップ16はアルミニウムであり、その他の構造は、実施例1の場合と実質的に同一である。なお、内部熱線吸収板9は、取り外してある。

【0018】モノシランガス及び笑気ガスからなる反応ガスを反応容器2に導入し、150℃の温度に維持したシリコン基板6に波長185nmの紫外線を照射することによって、シリコン基板6の上にシリコン酸化膜を形成した。熱電対による温度制御，放射温度計による温度制御、共に、基板温度のばらつき（再現性），均一性、並びに温度誤差は、極めて良好であって、所望の高品質を有するシリコン酸化膜を形成することが出来た。

【0019】また、図3と同様な装置構成で、反応ガスとしてオゾンガスを用い、基板上のレジストを除去した。基板は250℃に維持し、基板上の紫外線強度は約100mW／cm$^2$とした。基板表面との間隙0.5㎜の間に流量10リットル／分のオゾン含有酸化性ガスを流し、レジストを酸化した。この時のレジストの酸化速度（処理速度）は基板温度の変化1℃に対して約2％変化した。基板温度が低いと反応速度は遅くなるため、支持ピン部分での基板温度が低い場合にはその部分だけ未反応の残滓が残ることとなる。本発明の支持ピンを用いた場合のレジスト処理速度は遅い部分の早い部分に対する比が0.95 以上となり、均一性は問題ないことが確認出来た。

【0020】図4は、支持ピン14と基板6との接触角（キャップ16の面と基板6の面とがなす角）を調整する機構19を設けた本発明の別の実施例を示す構成図である。支持ピン14は角度調節機構19によりその周りに回転可能となっており、基板6が傾いた場合でも、キャップ16が基板6と面接触（接触角0度）すべく調節される。支持ピン14のキャップ16は基板6との熱抵抗を小さくするためにその頂部が平坦となっているが、基板6に反り等により傾きが生じていると、基板6と支持ピン14との接触面積は十分でなくなり、従って、検出温度誤差は大きくなる。この場合、検出される温度は基板6の実際の温度よりも低くなるため、角度調節機構19により支持ピンの角度をわずか動かし、検出される温度が最大となった位置での温度をもって検出温度とし加熱電力を制御する。この角度調節を行っている間は、他の測定温度データに基づき温度制御を行うか、又は、温調を一定とする。特に、基板6を真空中で加熱する場合には、接触角による検出温度の変化が大きく、接触角が1度の場合、基板温度と検出温度との誤差が約10℃であったものが、接触角を調整して、0度とした場合、4℃と少なくなった。

【0021】なお、実施例では、シリコン基板を加熱するための熱線照射ランプ3としてハロゲンランプを使用したが、赤外線ランプやセラミックヒータを非接触式に使用することも可能である。また、実施例では、被加熱基板として半導体基板を用いた場合について説明したが、ガラス基板を用いた場合も同様である。但し、ガラス基板を用いた場合には、その基板の熱伝導率がシリコン基板の熱伝導率よりも低いため、より一層基板の温度の均一性は悪くなる。また更に、支持ピンの基部22の材質として石英ガラスを用いた場合について説明したが、基部22の材質は、$MgO \cdot SiO_2$，$2MgO \cdot SiO_2$，$ZrO_2 \cdot SiO_2$等の酸化珪素含有のセラミックスが適している。何れにしても、基部22の材質の熱伝導率が基板およびキャップ16の熱伝導率よりも十分に低い無機材質であればよい。

【0022】

【発明の効果】本発明の半導体製造装置の温度検出装置では、測温体とその周りの熱抵抗を下げ、支持部の熱抵抗を上げることにより、半導体基板、或いはガラス基板の温度を正確に測定し、かつ、これら基板の温度むらを少なくすることができ、支持ピンの基部を無機材質で構成することにより有害な金属汚染を防止することが出来る。

【図面の簡単な説明】

【図1】本発明の半導体製造装置の第一の実施例を示す断面図。

【図2】本発明の半導体製造装置の温度検出装置の要部の断面図。

【図3】本発明の半導体製造装置の第二の実施例を示す断面図。

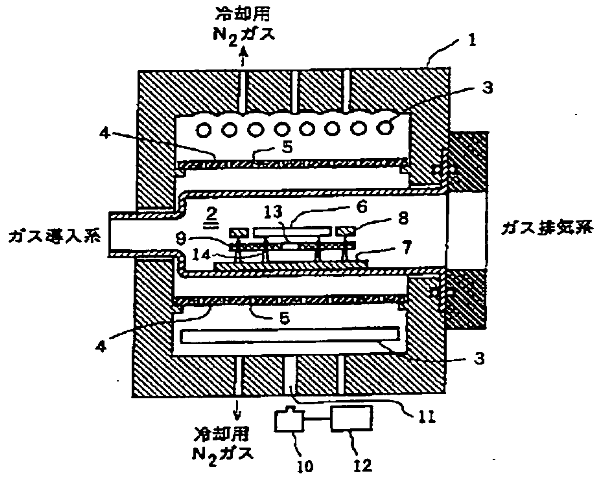
【図4】本発明の半導体製造装置の温度検出装置の要部の説明図。

【符号の説明】

14…支持ピン、15…熱電対、16…キャップ、17…基部、17a…基部頸部。

【図1】

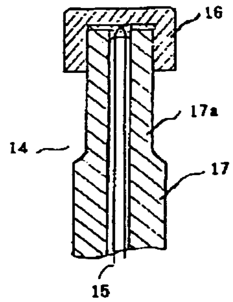
図1




1…装置本体
2…熱線透過性反応容器
3…熱線照射ランプ
4…外部熱線吸収板
5…通気孔
6…半導体基板
7…熱線透過性支持台
8…ガードリング
9…内部熱線吸収板
10…放射温度計
11…観測窓
12…電力制御装置
13…透孔
14…支持ピン

【図2】

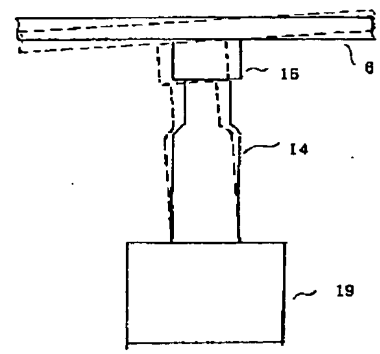
図　2



14…支持ピン
15…熱電対
16…キャップ
17…支持ピン基部
17a…基部頸部

【図4】

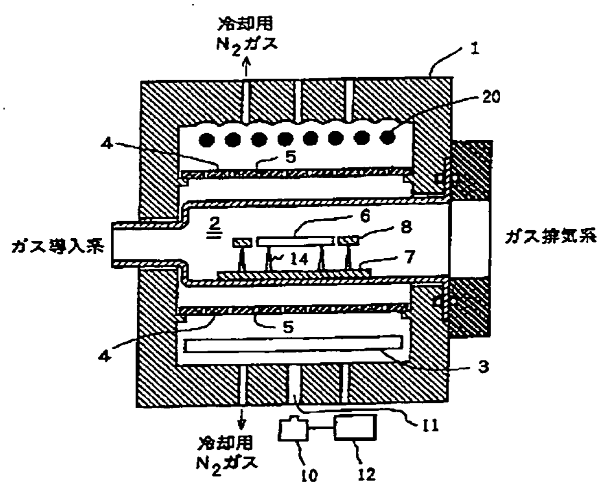
図　4



6…基板
14…支持ピン
16…キャップ
19…角度調節機構

【図3】

図3




1…装置本体
2…熱線透過性反応容器
3…熱線照射ランプ
4…外部熱線吸収板
5…通気孔
6…半導体基板
7…熱線透過性支持台
8…ガードリング
10…放射温度計
11…観測窓
12…電力制御装置
14…支持ピン
20…紫外線ランプ

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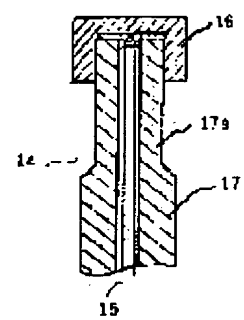
## (54) TEMPERATURE DETECTOR AND SEMICONDUCTOR MANUFACTURING DEVICE

(57)Abstract:
PURPOSE: To control the temperature of a semiconductor substrate or a glass substrate evenly and accurately.
CONSTITUTION: A semiconductor substrate or a glass substrate is supported by a support pin 14. A thermocouple 15 is provided in the interior of the pin 14 as a temperature detector of a semiconductor manufacturing device, wherein these substrates are subjected to heating treatment. The point part of the pin 14 is constituted of a high-thermal conductivity material and a base 17 of the pin 14 is constituted of an inorganic material of a thermal conductivity lower than that of the substrate. The thermocouple 15 is secured o the point part of the flat pin 14 and a neck part 17a is provided at the base of the pin 14.




LEGAL STATUS
[Date of request for examination]
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[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

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## CLAIMS

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[Claim(s)]
[Claim 1] Temperature detection equipment characterized by to have embedded the thermocouple at least one of the support pins which support said semi-conductor substrate or said glass substrate in the temperature detection equipment of the semiconductor fabrication machines and equipment which carry out temperature processing of a semi-conductor substrate or the glass substrate by non-contact, to have constituted the point of said support pin from an ingredient with thermal conductivity higher than the base of said support pin evenly, and to constitute the base of said support pin from said substrate with an inorganic material with low thermal conductivity.
[Claim 2] Temperature detection equipment characterized by having made the base of said support pin tubular, having inserted said thermocouple in claim 1 that a contact should be located in the point in tubing, and fixing near [ this ] the contact to a support pin point.
[Claim 3] Temperature detection equipment which made the cross section of the point of the base of said support pin smaller than the cross section of the other end in claims 1 or 2.
[Claim 4] Temperature detection equipment characterized by preparing the include-angle regulatory mechanism which makes adjustable the contact angle of the point of the above-mentioned support pin, and the above-mentioned substrate in claims 1, 2, or 3.
[Claim 5] Semiconductor fabrication machines and equipment which equipped with said temperature detection equipment the semiconductor fabrication machines and equipment which equipped one [ at least ] front face of a substrate with the source of a heat ray for irradiating the heat ray for heating in claims 1, 2, 3, or 4 from the outside of the reaction container of the heat ray transparency mold for containing said semi-conductor substrate or said glass substrate, and said reaction container.

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[Translation done.]

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the temperature detection equipment used for the semiconductor fabrication machines and equipment and them which use sources of a heat ray, such as semiconductor fabrication machines and equipment especially an infrared lamp, and a ceramic heater.
[0002]
[Description of the Prior Art] In order to raise the engine performance of a semiconductor device and to lessen dispersion in the engine performance, it is required among the manufacture process of a semiconductor device homogeneity and to control correctly the temperature of a semi-conductor substrate or a glass substrate, and some cures are already proposed.
[0003] For example, by the detection approach of temperature given in JP,4-98135,A, a temperature detector is covered with the cap which consists of the quality of the material with high thermal conductivity, and thermal resistance is reduced. Or by reference (JICST E91121096), alumina tubing is used as a support pin and the example which embedded the thermocouple to the interior is shown again. In these conventional example, although thermal resistance between a measurement board-ed and a temperature detector is lessened, sufficient consideration for the thermal resistance between a temperature detector and a support base is not made. Therefore, when it passed along the thermometry section and a lot of heat flowed out of a measurement board-ed, there was a fault which the temperature gradient of a temperature detector and a measurement board-ed increases to the temperature fall of the substrate of a test section itself and a list. Moreover, at that by which a temperature detector has metal base materials, such as SUS, there is a fault which generates metal contamination (for example, contamination by Fe and Cr) harmful to a measurement board-ed, and with thermometry equipment given in JP,4-148545,A, although the example which interpolates a temperature detector in a covering member is shown, consideration sufficient from a measurement board-ed for a heat flow rate is not made.
[0004]
[Problem(s) to be Solved by the Invention] About the temperature of a semi-conductor substrate or a glass substrate, it can control correctly and the purpose of this invention is to offer homogeneity, the improved semiconductor fabrication machines and equipment which harmful metal contamination does not produce, and its temperature detection equipment.
[0005]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention forms the point (a cap is called below) for the temperature detecting element which serves as the support pin of a semi-conductor substrate or a glass substrate evenly with the quality of the material with high thermal conductivity, forms the base cross section small qualitatively [ with thermal conductivity lower than a substrate ] of non-equipments, and fixes on said cap through the hole in which the contact of a thermocouple was prepared in said base. To low temperature treatment, aluminum or an alumina has a convenient alumina to high temperature processing, and silicon nitride or silicon carbide is possible for the quality of the material of the cap with such a property. Moreover, the quality of the material of a base has the compound of oxidization magnesium, such as quartz glass or a steatite, and oxidization silicon, or the convenient compound of zirconium oxide and oxidization silicon.
[0006]
[Function] The temperature detector (contact of a thermocouple) touches the substrate through a cap. At this time, the temperature gradient of a temperature detector and the temperature measurement section of a substrate is influenced with the thermal resistance of the contact section of a cap and a substrate,

the thermal resistance of a cap, the thermal resistance of a cap and a temperature detector, and the thermal resistance of a base (temperature detector supporter).
[0007] By making a cap tip flat, by decreasing the thermal resistance of the contact section of a cap and a substrate, making the quality of the material of a cap into what has high thermal conductivity, and making the thermal conductivity of a base low, the thermal resistance of a cap is decreased and, according to this invention, the thermal resistance of a base is increased. Moreover, the thermal resistance of a cap and a temperature detector is decreased by making a cap fix a temperature detector through tubing of a base. Therefore, with the temperature detection equipment of this invention, there is little thermal resistance of a temperature detector and a substrate, and the temperature gradient of a temperature detector and the temperature measurement section of a semi-conductor substrate decreases extremely. Moreover, by constituting a base from an ingredient with low thermal conductivity, and making the cap-side cross section of a base small, thermal resistance of a base is enlarged, the heat flow rate lost from a substrate can be lessened, the temperature fall of the temperature measurement section of a substrate is decreased to coincidence, and the homogeneity of the temperature of a substrate can be secured to it. Furthermore, a semi-conductor substrate or a glass substrate can prevent being polluted with poisonous metal by confining a thermocouple in the interior of a support pin, and constituting a support pin base qualitatively of non-equipments.
[0008]
[Example] One example of the semiconductor fabrication machines and equipment concerning this invention is shown in drawing 1. The body 1 of equipment has hollow structure, as shown in drawing, and the reaction container 2 made from quartz glass is arranged by the central part. In a form in which two or more heat radiation lamps 3 (for example, halogen lamp) carry out a vertical crossover, in the top space and bottom space of the reaction container 2, it arranges in parallel, and is arranged in them. The gutter-shaped lieberkuhn made from an aluminum containing alloy which gave the golden coat is arranged in head lining and the floor line of the body of equipment 1 interior, and the heat ray for heating irradiated from the heat radiation lamp 3 condenses towards the reaction container 2 efficiently.
[0009] The external heat ray absorption plate 4 is arranged in the vertical space between the heat radiation lamp 3 and the reaction container 2 (heat ray transparency space), respectively. In the case of this example, this absorption plate formed many bleeders 5 for using the thing made from quartz glass in which the **** glass side for heat ray diffusion was formed on the front face, and passing the nitrogen gas for cooling all over the. The semi-conductor substrate 6 which is a workpiece attached and loaded with the guard ring 8 on the diathermancy susceptor 7 installed in the pars basilaris ossis occipitalis of the reaction container 2. On the other hand, the thing made from quartz glass was used for the internal heat ray absorption plate 9, it was made to approach the semi-conductor substrate 6, and has been arranged to the heat ray transparency space of the bottom. This absorption plate can also be arranged in the both sides of a substrate 6 if needed.
[0010] Reactant gas and purge gas were exhausted using the flueing system on the right-hand side of a drawing (not shown), after introducing in the reaction container 2 from the gas feed system on the left-hand side of a drawing (not shown) and passing this container. Moreover, the water flow way is established in the interior of the wall of the body 1 of equipment, and the body 1 of equipment was cooled by letting cooling water pass on the water flow way concerned during use of equipment.
[0011] The temperature of a substrate 6 has arranged the radiation thermometer 10 to the body 1 down side of equipment, and measured it through the observation window 11 and the bore 13. Measurement data was transmitted to the power control unit 12, and controlled the power supplied to the heat radiation lamp 3 based on these data. Or the temperature of a substrate 6 was measured again with the thermocouple 15 which carried out interior to the support pin 14 of the diathermancy susceptor 7, as shown in the important section expanded sectional view shown in drawing 2 . The support pin 14 is cap 16 and the diameter of 3.5mm with the flat crowning which consists of an alumina with a diameter of 4mm. Consisting of a base 17 which consists of quartz-glass tubing, the crowning of a base 17 is the diameter of 2.5mm. It is extracted and has become base cervix 17a. The joint has fixed the thermocouple 15 on the cap 16 with inorganic adhesive. As well as the case of a radiation thermometer, measurement data was transmitted to the power control unit 12, and controlled the power supplied to the heat radiation lamp 3 based on these data. The radiation thermometer 10 and the thermocouple 15 were changed suitably, and were used.
[0012] In addition, during use of equipment, in order to prevent each part material becoming an elevated temperature exceeding allowable temperature, the nitrogen gas for cooling was blown into the gap between the body 1 of equipment, and the reaction container 2, and these members were cooled.
[0013] When it loaded with the raw semi-conductor substrate (silicon substrate) 6 into the reaction

container 2 and annealing treatment was performed at the temperature of 1000 degrees C by such manufacturing installation, dispersion in the temperature for every substrate obtained about 1 degree C and a good result. When same annealing treatment was performed using the silicon substrate in which the polish recon film was formed on the front face, and the silicon substrate which gave the ion dope to the front face, although dispersion was as good as about 1 degree C, by the temperature control using a thermocouple 15, the value of dispersion became large with about 10 degrees C by the temperature control using a radiation thermometer 10. Moreover, the error of the temperature of a silicon substrate 6 and the detection temperature by the thermocouple 15 is as fixed as about 4 degrees C, and it became clear by amending and using 4 degrees C of this error for the temperature control of a silicon substrate 6 that it is controllable with a sufficient precision. Furthermore, there were few differences of the silicon substrate temperature near the support pin 14 embedding a thermocouple 15 and the substrate temperature of the circumference of it as about 2 degrees C, and the temperature of a substrate was uniform.
[0014] For a comparison, the cap 16 of a support pin is formed with an alumina with a diameter of 4mm. The place which similarly formed the base with quartz-glass tubing with a diameter of 4mm, and experimented by being the same as the above-mentioned conditions, The error of the temperature of a silicon substrate 6 and the detection temperature by the thermocouple 15 became about 7 degrees C, and the difference of the silicon substrate temperature near the support pin 14 embedding a thermocouple 15 and the substrate temperature of the circumference of it became about 10 degrees C and an ununiformity further. Although the thermal conductivity of quartz glass is low, since that cross section is large, this cause is guessed because a lot of heat flowed into the direction of a support pin from the semi-conductor substrate 6. Therefore, since a mechanical strength becomes weaker, it is thermally convenient [ the size of the support pin 14 is suitable for the thermometry so that it is thin, but ] to make thin the cervix which stress cannot concentrate easily.
[0015] Furthermore, form with the cap 16 of a support pin, and both the bases 17 are formed in a list with an alumina with a diameter of 4mm for a comparison. When it experiments by being the same as the above-mentioned conditions, the error of the temperature of a silicon substrate 6 and the detection temperature by the thermocouple 15 is as large as about 15 degrees C. And the value was not fixed, the difference of the silicon substrate temperature near the support pin 14 embedding a thermocouple 15 and the substrate temperature of the circumference of it was still as larger as about 40 degrees C, and the temperature of a substrate was uneven. Although the difference of extent also has this cause, it is guessed because the thermal resistance of a base 22 is low as well as the above-mentioned cause.
[0016] Thus, when semi-conductor substrate temperature is measured by the low support pin of thermal resistance, in order to investigate the cause by which substrate temperature becomes uneven The susceptor 7, the guard ring 8, and the internal heat ray absorption plate 9 of the semiconductor fabrication machines and equipment shown in drawing 1 are demounted. Instead, the semi-conductor substrate was directly carried on the ceramic heater, the semi-conductor substrate was heated at the heater, and substrate temperature was measured with the thermocouple 15 formed in the support pin which formed both the cap 16 and the base 17 with the alumina with a diameter of 4mm. Consequently, the difference of the silicon substrate temperature near the support pin 14 and the substrate temperature of the circumference of it decreased with about 5 degrees C. When heating the semi-conductor substrate 6 by the contact method, therefore, the heating value which a substrate receives from a heating object As opposed to the operation which reduces the temperature gradient arising, when a temperature gradient arises in a substrate, since it is proportional to the temperature gradient of a heating object and a substrate In heating the semi-conductor substrate 6 with a non-contact method, for example, an infrared lamp It is concluded as that to which a temperature gradient will arise around it if the outflow of heat arises partially, since the heating value which a substrate receives is equal, the temperature of the semi-conductor substrate 6 is high especially, and the temperature change of a semi-conductor substrate becomes large around a support pin when the thermal resistance of a support pin is low.
[0017] Drawing 3 shows another example of this invention in the case of forming silicon oxide on a silicon substrate. In this example, the low-pressure mercury lamp 18 (ultraviolet ray lamp) has been arranged to the top space of the reaction container 2, and the halogen lamp 3 (heat radiation lamp) has been arranged to the bottom space of the reaction container 2. Cap 16 is aluminum and its other structures are substantially [ as the case of an example 1 ] the same. In addition, the internal heat ray absorption plate 9 is removed.
[0018] Silicon oxide was formed on the silicon substrate 6 by introducing into the reaction container 2 the reactant gas which consists of mono-silane gas and laughter gas, and irradiating ultraviolet rays with a wavelength of 185nm at the silicon substrate 6 maintained in temperature of 150 degrees C. Both

temperature errors were able to form in dispersion in substrate temperature (repeatability), homogeneity, and a list the temperature control by the thermocouple, the temperature control by the radiation thermometer, and the silicon oxide that is very good and has desired high quality.

[0019] Moreover, the resist on a substrate was removed by the same equipment configuration as drawing 3 , using ozone gas as reactant gas. The substrate was maintained at 250 degrees C and ultraviolet-rays reinforcement on a substrate was made into about 100 mW/cm2. The sink and the resist were oxidized between 0.5mm of gaps on the front face of a substrate in the ozone content oxidizing quality gas for flow rate/of 10l. The oxidation rate (processing speed) of the resist at this time changed about 2% to 1 degree C of change of substrate temperature. Since a reaction rate will become slow if substrate temperature is low, when the substrate temperature in a support pin part is low, remnants only with the unreacted part will remain. For the resist processing speed at the time of using the support pin of this invention, the ratio to a part with a late early part is 0.95. It became the above and has checked that homogeneity was satisfactory.

[0020] Drawing 4 is the block diagram showing another example of this invention which established the device 19 in which the contact angle (angle which the field of cap 16 and the field of a substrate 6 make) of the support pin 14 and a substrate 6 was adjusted. The support pin 14 has become pivotable around it by the include-angle regulatory mechanism 19, and even when a substrate 6 inclines, cap 16 is adjusted that field contact (zero contact angle) should be carried out to a substrate 6. In order to make thermal resistance with a substrate 6 small, the crowning of the cap 16 of the support pin 14 is flat, but if the inclination has arisen by curvature etc. in the substrate 6, the touch area of a substrate 6 and the support pin 14 will become less enough therefore, and a detection temperature error will become large. In this case, since the temperature detected becomes lower than the actual temperature of a substrate 6, it is made into detection temperature with the temperature in the location where the include angle of a support pin was only moved by the include-angle regulatory mechanism 19, and the temperature detected became max, and controls heating power. While performing this include-angle accommodation, temperature control is performed based on other measurement temperature data, or temperature control is set constant. When heating a substrate 6 in a vacuum especially, change of the detection temperature by the contact angle was large, and when that whose error of substrate temperature and detection temperature was about 10 degrees C when a contact angle was 1 time adjusted a contact angle and considered as 0 times, it decreased with 4 degrees C.

[0021] In addition, although the halogen lamp was used as a heat radiation lamp 3 for heating a silicon substrate in the example, it is also possible to use an infrared lamp and a ceramic heater for a non-contact type. Moreover, although the example explained the case where a semi-conductor substrate was used as a heated substrate, it is also the same as when a glass substrate is used. However, since the thermal conductivity of the substrate is lower than the thermal conductivity of a silicon substrate when a glass substrate is used, the homogeneity of the temperature of a substrate worsens further. Furthermore, although the case where quartz glass was used as the quality of the material of the base 22 of a support pin was explained, as for the quality of the material of a base 22, the ceramics of oxidation silicon content of MgO-SiO2, 2 MgO-SiO2, and a ZrO2 and SiO2 grade is suitable. Anyway, the thermal conductivity of the quality of the material of a base 22 should just be a substrate and the quality of non-equipments lower enough than the thermal conductivity of cap 16.

[0022]

[Effect of the Invention] With the temperature detection equipment of the semiconductor fabrication machines and equipment of this invention, by lowering a temperature detector and the thermal resistance around it, and raising the thermal resistance of a supporter, the temperature of a semi-conductor substrate or a glass substrate can be measured correctly, and the temperature unevenness of these substrates can be lessened, and harmful metal contamination can be prevented by constituting the base of a support pin qualitatively of non-equipments.

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[Translation done.]

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] The sectional view showing the first example of the semiconductor fabrication machines and equipment of this invention.
[Drawing 2] The sectional view of the important section of the temperature detection equipment of the semiconductor fabrication machines and equipment of this invention.
[Drawing 3] The sectional view showing the second example of the semiconductor fabrication machines and equipment of this invention.
[Drawing 4] The explanatory view of the important section of the temperature detection equipment of the semiconductor fabrication machines and equipment of this invention.
[Description of Notations]
14 [ -- A base, 17a / -- Base cervix. ] -- A support pin, 15 -- A thermocouple, 16 -- A cap, 17

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[Translation done.]